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**Systematic Construction of tight-binding Hamiltonians for Topological Insulators and Superconductors**[1] DONG-LING DENG, SHENGTAO WANG, LUMING DUAN, Department of Physics, University of Michigan, Ann Arbor, Michigan 48109, USA — A remarkable discovery in recent years is that there exist various kinds of topological insulators and superconductors characterized by a periodic table according to the system symmetry and dimensionality. To physically realize these peculiar phases and study their properties using ultracold atoms in optical lattices, a critical step is to construct experimentally relevant Hamiltonians which support these topological phases. We propose a general and systematic method based on the quaternion algebra to construct the tight binding Hamiltonians for all the three-dimensional topological phases in the periodic table characterized by arbitrary integer topological invariants, which include the spin-singlet and the spin-triplet topological superconductors, the Hopf and the chiral topological insulators as particular examples. For each class, we calculate the corresponding topological invariants through both geometric analysis and numerical simulation. Our method can be straightforwardly generalized to one- and two-dimensions, and thus paves the way to implementation of various topological phases in optical lattices.

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